1607/3659.

A COMPANION TO THE LADIES DIARY, FOR THE YEAR 1781.

CONTAINING

ÆNIGMAS, REBUSSES,
MATHEMATICAL ESSAYS,
QUESTIONS AND SOLUTIONS, &c.

By REUBEN BURROW,

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ANSWERS to the QUERIES, REBUSSES, &c. in Laſt Year's DIARY.

Query I. Anſwered by Mr. Legg.

MILNE in his Botanical dictionary, ſays, There is a reſinous vapour continually iſſuing from this plant, which forms a kind of atmoſphere around it, which if true, accounts for the Phœnomenon.

Query II. Anſwered by Miſs Willis.

The reaſon why the ſun appears red at his ſetting, is, becauſe the red rays of light are the ſtrongeſt, the others being loſt in the large body of the atmoſphere which prevents them reaching the eye; this alſo is the cauſe of the red tinge obſerved on objects under water by divers.

Query III. Anſwered by Miſs Lee.

There ſeems to be ſo many different ways of accounting for the origin of the popular belief of faries, that it is very difficult to pitch on any particular one with any degree of certitude. As the Arabic and Perſian, Mythology, and their Fables and Stories are ſo full of thoſe imaginary beings, many have ſuppoſed them of oriental extraction; others conſider them as the ſucceſſors of the nymphs and inferior ſilvan deities of the Grecians; but from all the deductions I have ſeen, it does not appear that one has a better claim than the other; there ſeems one very ſtrong argument againſt both, that thoſe two opinions preſuppoſe ſome knowledge of literature, and it is well known that the belief of Faries obtains in the moſt ignorant parts of the northern nations, and therefore it is much more probable that the opinion has ariſen from ſome of the ancient northern ſuperſtitions of which we have no particular account; eſpecially as it appears from Olaus Magnus and the Edda, &c. that Scandinavia had a ſufficient cargo of gods, demons, witches, &c. without importing any from Greece or Arabia.

Query IV. Anſwered by Mr. S. Rogers.

This Query ſeems to be ſimilar to that propoſed to the Royal Society, about the wonderful fiſh which put into a pail of water would not add to its weight; after many *ample* diſſertations and profound reſearches, conducted with the moſt ſolemn gravity, one of them propoſed to try the fact. I am afraid the propoſer has made a ſimilar miſtake, for I do not find any remarkable difference between the appearances whether the paper moves or is ſtationary, provided it be preſſed equally cloſe at both times, and what ſmall difference there is ſeems to be owing to the paper being perhaps a little thinner in ſome parts than others.

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Query V. Anſwered by Callum Macgreggor.

The ſkin upon the face is thinner than any other part of the body; now the itch being cauſed by inſects (as the Royal Society have demonſtrated) they naturally ſeek the deepeſt parts and conſequently the face is avoided.

Query VI. Anſwered by Mr. John Clarke.

That Edward Wright invented a ſet of numbers which might be made to ſerve the purpoſes of Logarithms, is allowed; but as it does not appear that he had any idea of their having ſuch a property, it would be a great impropriety to give him the title of an inventor on that account, though he wrote before Lord Neper.

Anſwer to the VII. Query. By Caput Mortuum.

It is impoſſible to trace the origin of cutting wooden-blocks for the purpoſe of taking off pictures, for it is well known that the Chineſe had the art long before it was known to the Europeans, tho' probably the latter practiſed it ſoon after the invention of cards, which at firſt it ſeems were done entirely with the pencil; this, according to the French hiſtorians, was about the year 1390, when a French painter named *Jaquennin Gringonneur* invented them for the amuſement of Charles VII. during his illneſs; but in a Book called in French *Le jeu d'or*, printed in 1472, it is ſaid that cards were uſed in Germany about the year 1300: Be this, however, as it may, it is almoſt certain that the firſt blocks were cut for making cards, and *that* long before the invention of Printing.

That the firſt printed books were ornamented with wood cuts appears from the *Pſalter* printed at *Mayence* in 1457.

The Germans and Italians have long diſputed about the origin of engraving on plates of metal; each laying claim to the invention; the latter affirm that it was diſcovered about the year 1460 by *Maſo Finiguerra*, a goldſmith of Florence; on the contrary, M. Heineke, in his "*Idée génerale d'une collection d'Eſtampes*" endeavours to prove that it was known in Germany before the year 1450.

Mr. Baſan in his "*Dictionnaire des Graveurs*" ſeems inclined to favour the Italians, he ſays, that *Boticelli* having engraved the Prophets and Sybils about the year 1460, the Germans copied them, tho' imperfectly; but of this he has not given proofs, which indeed was not eaſy, as moſt of the firſt prints are without dates, or names of the engravers.

The firſt book we meet with where copper, or metal plates were uſed with the letter preſs, or on the ſame leaf with the printing, is the edition of *Dante* printed at Florence, "per Nicholo di Lorenzo della magna a di 30 d'Agoſto 1481;" the ſame year the *Miſſale Herbipolence* was printed in Germany; the mandate of the biſhop to the printer J. Keyſer is dated Nov. 8. 1481, this is ornamented with copper, or metal plates, but by the date

(Nov. 8.) we may ſuppoſe that it was not finiſhed quite ſo early as the edition of Dante.

But, there are proofs that copper, or metal plates were invented a great while before 1481. *Sandrant* mentions a print dated 1455, where a young girl is repreſented picking an old man's pocket while he is careſſing her: and M. Heineke deſcribes another, ſtill older, the ſubject is, a ſybil ſhewing to the Emperor Auguſtus the image of the Holy Virgin in the air.

M. de Bure gives an account of an edition of Ptolemy's Coſmography where we read this date, "*Opus impreſſorum Bononiæ per Dominicum de Lapis*, anno M.CCCC.LXII." This has 26 geographical charts engraved on copper, or metal plates, but having ſome doubt about the date (1462) he ſuppoſes the *true* date to be 1472: M. Breitkopf according to M. Heineke, ſuppoſes that the printer inſerted an I for an L, and accordingly he reads M.CCCC.LXLI. (1491) but M. Heineke has proved beyond a doubt that 1462 cannot be the true date. There is another edition of Ptolemy printed at Rome in 1478, which de Bure has not taken notice of, in which are 27 charts from metal plates; in the dedication we read that C. Sweynhem, a German, carried the art of printing to Rome, and at the ſame time the art of working from plates of metal, and that he was ſucceeded by A. Buckink another German who finiſhed the work for this edition.

It is ſomewhat remarkable that no print can be found, which, with certainty, can be attributed to Finiguerra, tho' B. Baldini, and S. Boticello learned the art of him, and engraved a great number, among which are the two plates in the above mentioned edition of Dante.

Mr. Evelyn in his *Sculptura*, as quoted by Mr. Walpole in his catalogue of Engravers, ſays, the art of engraving and working off from plates of copper did not appear till about the year 1490, but this is without proof, as it cannot be ſhewn upon what metal the plates in Dante or Ptolemy were engraven, tho' it ſeems likely when the art was diſcovered they might engrave on ſofter metal than copper: when A. Durer took it in hand he engraved on all kinds of metal.

It may not be improper to point out two miſtakes in Palmer's Hiſtory of Printing, page 391. where it is ſaid that 1467 is the oldeſt date any Author has mentioned, whereas we have given that of Sandrant 1455; and again, he ſpeaks of *Andrea de Murano* as an engraver in 1412, but this a miſtake, we ſhould read 1512.

VIII. QUERY, anſwered by Archimedes.

What the real name of the learned perſon here ſpoken of, might be, is not very eaſy to determine with certainty, ſince in his own book he is both called Richard and Raymond; Voſſius and Cardan call him John, and Biſhop Tanner calls him Roger; there is the ſame uncertainty with reſpect to his country, for Voſſius and Cardan make him a Scotchman, but Brucker, who ſeems to have ſpared no pains for information, poſitively aſſerts him to have been an Engliſhman; the different Surnames of Suiſeth, Swiſſett, Swincetus, Suicetus and Suineſhevedus, by which different authors diſtinguiſh him, ſeem all to owe their riſe to his having been a Monk, in the Abbey of Swineſhead in Hoyland, Lincolnſhire; eſpecially as he lived at a time when few names were patronymical, but moſtly derived from circumſtances of locality: he was Fellow of Merton College in 1349, and became a Monk the following year at Swineſhead; the appellation of *Calculator*, by which he is often mentioned, aroſe from his writing a book called, "*Introductorum ad calculationem*," or perhaps from his "*Calculationes Aſtronomicas*," according to Brucker, in whoſe work a liſt of his Treatiſes may be ſeen with ſome account of their contents.

Query IX. Anſwered by Miſs Kitty C——m.

This ſeems to be cauſed by the heat of the ſun rarifying the air, the conſequence of which is, that it cannot act with that force on the fire as it otherwiſe would do.

Query X. Anſwered by the ſame.

This ſeems owing to the indiſtinctneſs of the out-line.

Query XI. Anſwered by Poor Robin.

Hiſtory does not furniſh us with any very early obſervations reſpecting the matter in queſtion; ſome of the firſt we meet with are in the voyages of Capt. Frobiſher, and Seb. Cabot, who give an accouut of "Monſtrous iſles of ice in taſte freſh." Capt. G. Weymouth, in his voyage for the diſcovery of a Northweſt paſſage in 1602 is more particular, where ſpeaking of the large iſlands of ice in the North Seas, "being in great want of freſh water, we hoyſed out our boats and loaded them twice with ice, which made us very good freſh water." Mr. Boyle takes notice of this, and, ſays, in another place, that the liquor of thawed ſalt-water ice is fit for uſe, which he proved by experiments. Mr. Nairne has given a paper on the ſame ſubject in Vol. 66. of the Philoſophical Tranſactions, where he again proves what was known before; nay, an ingenious gentleman who lately died in his return from the Eaſt-Indies, had long before propoſed a ſcheme for making ſalt in winter by ſeparating the freſh particles by means of froſt; as to its being lately talked of as a new diſcovery, that ſeems to owe its riſe to a pamphlet publiſhed by Sir John Pringle, preſident of the Royal Society, in which (according to the uſual practice of that learned body, in paying honours to each other and printing their compliments) that learned gentleman, in order to embelliſh his oration, aſſumes a liberty which, though of no uſe in philoſophy, is of excellent ſervice to travellers and poets, I mean that figure in rhetoric which ſpeaks of things known as unknown. For it cannot be ſuppoſed that ſo learned a perſonage ſhould be unacquainted with a fact ſo remarkable, and therefore when on finding freſh ice he ſo pathetically exclaims—“ Here then was a wonder of the deep! This is as I may ſay the Romance of his voyage!” It is doubtleſs to be underſtood as a flower of oratory, which “ flounced from him involuntarily,” or perhaps was adapted to the hearers or the occaſion or both, and could not be meant to be underſtood literally as ſpeaking of a thing unknown.

Query XII. Anſwered by Mr. Rogers.

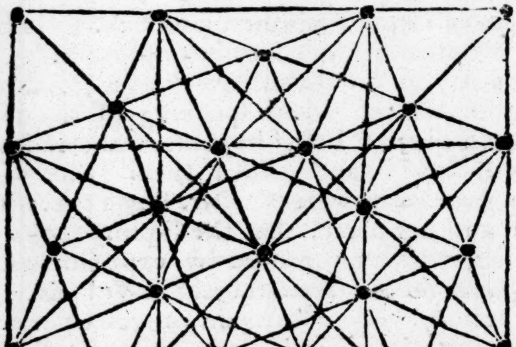
The great velocity given to an arrow is the effect of an accumulation of continued preſſures, in the ſame manner as the velocity of a ball in a piece is generated, or as falling bodies have their velocities increaſed by the action of gravity.

Anſwers to the Enigmas in the laſt Year's Diary.

I. *A Frog.*
II. *A Grater.*
III. *An Oak plank.*
IV. *A Taylor.*
V. *The Moon.*
VI. *A Smoothing Box.*
Prize. *An Apple Dumpling.*

Anſwer to the Paradox; by Mr. J. Langdale, addreſſed to the Propoſer.

In your thirty four rows I have plac'd thirty trees,
Which if you diſpute you may count if you pleaſe.



Miſs Cockbills Rebus acroſtically anſwered, by Mr. J. Langdale; addreſſed to Miſs B——.

I-f e'er my charmer you have felt love's pain,
S-hew ſome compaſſion to your love-ſick ſwain;
A-ccept the paſſion of your humble ſlave,
A-nd ſave a dying lover from the grave:

C-onſtant to thee for ever will I prove;
D-eath only can my deep fixt love remove:
A- flame more pure did mortal ne'er inſpire,
L-ove ſears my heart with unextinguiſh'd fire:
B-ut may I hope (my anguiſh to remove)
Y-ou e'er will grant me a return of love?

A general Anſwer to all the Enigmas by Mr. Timothy Sly of Carlton Huſthwaite, Yorkſhire.

Enigma the firſt is a *Frog* without doubt;
The ſecond a *Grater* will clearly make out.
The third I am ſure is a ſtrong *Oaken Board*;
The fourth I ſuppoſe is a *Taylor*, good Lord!
The fifth Madam *Luna*; the ſixth is a *Box*,
For ladies to iron their fine holland ſmocks.
A large *Apple Dumpling* will ſerve for the Prize
(A ſight not unwelcome to countrymen's eyes)
In Miſs Betſy's Rebus, friend *Dalby* has part,
How happy ſhould I be to ſhare in her heart!

General anſwer to the ſame, by Explorabilis.

A *Frog* is the firſt, and a *Grater* the ſecond,
An *Oak* and a *Taylor* the next two are reckon'd;
The *Moon* and a *Box-Iron* anſwer two more,
And a large *Apple Dumpling* the prize will explore.

Anſwer to the Enigmas, by Mr. John Langdale.

I. Walking out for freſh air, near a *Grove* t'other night, III.
When all things were ſtill, and the *Moon* ſhining bright, V.
I heard a young ſhepherd addreſs a fair maid,
In the language of love, and thus to her he ſaid;

II. Oh! Phillis, my charmer, be kind to your ſwain,
And eaſe a fond lover's ſoft languiſhing pain,
For ſo deep is my wound, and ſo keen is the ſmart,
That unrivall'd alone you reign in my heart;

III. I've a farm of my own, and furniture ſtore,
Both *Smoothing Box*, *Grater*, and twenty things more, VI. II.
And if you'll conſent my ſweet bride for to be,
I will freely beſtow all I have upon thee;

IV. My *Eggs* and my *Butter*, thou ſweet lovely fair, *Prize*.
I wholly reſign to thy conduct and care;
Moreover i'll ſend for a *Taylor* ſtraightway, IV.
And deck them my jewel in cloths fine and gay;

V. Come, come then my charmer no longer be ſhy,
Nor vainly endeavour your love to deny,
O why do you leap like a *Frog* from your ſwain, I.
That muſt certainly die if you eaſe not his pain;

NEW REBUSSES, QUERIES, &c. to be anſwered in the next Year's Diary.

I. Rebus. By Mr. Samuel Rogers.

Two-thirds of a bard, of whoſe works few remain,
By Horace belov'd, and the Mantuan ſwain:
The Initial of her that Narciſſus o'er paſt,
And what we muſt do when we keep a rope faſt.
It is what all mortals with ardour purſue,
But moſtly, ye fair, when 'tis ſought for by you.

II. Rebus. By Mr. J. Clark, of Lincoln.

Take half of him whoſe epic page
Adorn'd the great Auguſtan age;
With that which vulgar people drink,
Diſperſing round an odious ſtink:
And they together, when combin'd,
Will name a thing that's hard to find.

III. Rebus. By *Explorabilis.*

A nut that is large, when divided in two,
Will name a fam'd poet without more ado.

IV. Rebus. By Mr. John Willes.

From a long ancient note the laſt letter take;
Reverſe the remainder, and then it will make
A part of our ſpeech by the vulgar abus'd,
And by the illiterate often miſus'd.

V. An Acroſtical Rebus. By Mr. J. Langdale.

A famous hero that went down to hell,
A Trojan chief that by Achilles Fell,
A Grecian prince, who his own mother ſlew,
A god, the judge of the infernal crew;
A river famous for its golden ſands,
A queen who periſhed by her lover's hands,
A fam'd muſician who could tygers tame,
And the chief god that rules the raging main.
The initials of theſe lines conjoin'd, declare
A prudent beautiful and blooming fair.

I. Query. By M. J. Willes.

What are we to underſtand by the two daughters of the horſeleach, which cry, "give, give?" Prov. xxx. xv.

II. Query. By Inquiſitor.

Is there any practical method that will actually prevent the growth of human hair, or totally eradicate that already grown?

III. Que-

III. Query. By Mr. Willliam Redmayn.

Whether have laws been upon the whole favourable or detrimental to the propagation of the human ſpecies?

IV. Query. By Miſs Lee.

What claſs of people may be the eaſieſt ſpared in a ſtate of Artificial Society?

V. Query. By Miſs Elizabeth Williams.

Whether is an impudent, or an hyprocritical rogue, the moſt deteſtable?

VI. Query. By Mr. Thomas Penſon.

Who was the perſon that Mr. Pope's "Elegy on the Death of an unfortunate Lady," was written upon?

VII. Query. By Mr. John Legg, of Eaſt Lavington, Wilts.

Whether the ſouls of men departed are privy to our actions, and can appear or diſappear to human ſight?

VIII. Query, by the ſame.

What is the cauſe of the contraction of the leaves of the ſenſitive plant on being touched?

NEW ENIGMAS to be anſwered in next Year's Diary.

I. Enigma. By Mr. John Willes, of Marſk.

When Phœbus god of day retires to reſt,
And with celeſtial gold has ſtreak'd the weſt;
When Night her ſable curtains cloſe has drawn,
And ſpread her mantle o'er the flow'ry lawn;
When vallies diſappear and purling rills,
Enamell'd plains, and high aſpiring hills;
Ladies in contemplation then ariſe,
And view me center'd in the azure ſkies;
Yon vaſt empyrian ſapphire arch behold,
Magnificently fill'd with ſpangl'd gold;
Where worlds unnumbered in the vaſt expanſe,
Harmoniouſly perform their myſtic dance;
There, with thoſe radiant orbs, a ſplendid train,
In midſt of bliſs, perpetual, I remain.
This terrene ball, tho' of enormous ſize,
My wondrous form could never yet compriſe;
Yet Neptune's fluid kingdom me contains,
Conſpicuous I am in that monarch's vaſt domains;
Majeſtic grandeur, dignity and ſtate,
On my four brethren conſtantly do wait;
And tho' their glories are extended wide,
O'er them tranſcendently I do preſide;
My crowned head which none of them can boaſt,
Ennunciates me Sovereign of the Hoſt.

I'm

With brilliant eyes, now, O ye ſapient fair!
View me in liquid, circumambient air,
Explore the center of that boundleſs ſpace,
You'll then exult, unveil'd to find my face.

II. Enigma. By Mr. John Clark, of Lincoln.

I'm gay, I'm giddy, gad about,
Am ever preſent at a rout;
And in the Park am often ſeen,
With all the charms of ſweet fifteen:
At Ranelagh and trim Vauxhall,
At Maſquerade and Freſco ball;
And in the front box at the play,
I love to ſhew myſelf away:
I'm often prancing on a Poney,
In Rotten Row with Macaroni;
At opera I hear Rauzini,
Signora Pozzi and Seſtini;
Among the noiſy lawyers go,
And in the pulpit make a ſhow:
The hungry poet oft' I feed,
And make him ev'n rejoice in need;
I'm preſent at each public ſport,
And never abſent from the court.
Sir Gobble Greenfat of the city,
Attended by his Lady Witty;
(The one for ſize and fat renown'd,
And one with ſpreading antlers crown'd)
When they to Iſlington repair,
I always wait upon them there;
Their civic conſequence diſplay,
And dictate every word they ſay.
I talk with all on this or that,
In different things, no matter what;
And tell of wonders ſeldom heard on,
How doctor *Graham*, with his beard on,
Could in his Temple of Hygæa,
Infallibly cure gonorrhœa,
The p—, the itch, and ſuch diſaſters,
Too incident to little maſters.
Then at the tables of the great,
I ſpeak about affairs of State;
Our mighty ſtrength at land and ſea,
Our battles in America:
Then with fine ladies in brocade,
Sum up the conqueſts they have made;
I praiſe their features and their faces,
Their twenty thouſand ſmiling graces;
And with ſuch ſly deceitful arts
Attain poſſeſſion of their hearts.——

Coarſe

I'm light, fantaſtic in my dreſs,
Have whims beyond all mortal gueſs;
And likewiſe inexhauſted paſſion,
To be the very height of faſhion:
But I am nought but idle ſhow,
And men of ſenſe will find me ſo.

III. Enigma. By Miſs Willis, of Briſtol.

Tell me, gentry, what's the cauſe,
I diſdain all human laws?——
Tho' I'm rais'd above the ſky,
Yet theverieſt ſlave am I;
To a mortal humbly fawn,
Tho' repaid with ſtripes and ſcorn;
Gilded chambers I deſpiſe,
Cupid's ſhaft about me flies
Harmleſs, ev'n from Chloe's eyes.
Greater than the proudeſt king—
Lower than the meaneſt thing;
Heedleſs of the niceſt feaſt ——
Yet devouring like a beaſt:
Coarſe and vulgar is my bed,
I've no place to eaſe my head.
Drowſy Morpheus with his train,
Where I dwell, ne'er holds his reign.—
Diſcord, ever waking fiend,
Haunts my chamber without end:
Yet ſhe charms me with her cries,
Lifts my ſoul to extaſies.
Outcaſt am I of the world,
Therefore in a corner hurl'd.
What I am you may attain,
If you puzzle much your brain.——

IV. Enigma. By Mr. Samuel Rogers.

I could oblige, and would, if all did pay
Me due attention, equally obey:
It matters not to me, tho' hack'd and torn,
Who 'tis I ſerve or whoſe fair hand adorn:
I'm treated ill, and always caſt aſide
When I'm grown old and paſt all uſe beſide;
When taken firſt I'm ſtrait diſrob'd, and ſtripp'd,
Beheaded, flay'd and mangl'd, ſcratch'd and ripp'd:
Yet dire neceſſity doth this produce,
Since I without it am of little uſe:
'Tis then I'm moiſten'd, if the truth I tell,
And us'd when reeking from a dreary well;
I ſpeak a language too, that's quite confus'd
And grumble much when much by boys miſus'd;
The abſent lover courts me, and in trade,
I bear a part, a mighty part 'tis ſaid:

I'm of all countries, colours, and moſt ſhapes,
In ev'ry manſion, ſcarcely one eſcapes:
Am in eſteem with kings, as well as thoſe
Who court the muſe, and all in me repoſe;
Take one hint more—I, when in my firſt ſtate,
Skimm'd thro' the atmoſphere——My name relate?

V. Enigma. By T. P.

Say, lovely maid, from whence deriv'd?
That I ſhould be compar'd
With giddy youth, or how contriv'd
That you and I are pair'd:
For many years, ſince Adam's birth,
I've been upon the town;
But yet, I cauſe much nightly mirth,
So pray forbear your frown:
Soon from theſe joys I change my mien,
If paſſions ever ſeize,
Deſtroy your love-ſick purling ſtream,
Not eaſy to appeaſe.
Forboding ſtorms on me attend;
I preſs the liquid bed,
But yet the merchant muſt commend,
When I my care o'erſpread:
I'm oft the ſweeteſt breath of love,
Where rooks to rocks withdraw,
I wake to ſound the nodding grove,
Bid Echo learn to caw:
And yet my fair, when frights approach,
When ſinking ſpirits fade,
You muſt my province quick encroach,
So much I am your aid.

VI. Enigma. By the Same.

It muſt come out, 'tis no miſtake,
I even bluſh whene'er I ſpeak;
Almoſt aſham'd to own the truth,
Whate'er the prudes may ſay forſooth;
Without my aid, no woman's ſmile,
Will men of virtue e'er beguile.
Seldom am ſeen in pomp or power,
Deſpiſe the mighty rev'ling hour!
Oft' baſe detraction brings a tear,
To pimps, and bawds, oft' fall a ſnare:
Much oftner in the country bed,
I ever grace a maiden-head,
If loſt, I ne'er reſiſt a flame,
But love without all fear or ſhame:
Have no reluctant hand to ſeize,
Then give a doubtfull joy to pleaſe,

Pray ladies what's this maiden jewel,
That is ſo ſcarce, and yet ſo cruel.

Prize Enigna (of 10 Diaries). By Miſs Willis.

Say what am I, begot at dead of night
By roving fancy and ſome airy ſprite,
Bereft of ſubſtance, as beſpeaks my birth,
Yet ever active do I roam the earth:
Sometimes near bubbling fountain am I ſeen,
In flow'ry field, or on the hillock green;
Sometimes in ſhady grove, or cool retreat,
Or woodbine bow'r I take my welcome ſeat.
In pop'lous city, ſometimes I alight,
Yet there, alas! am often put to flight
By noiſe and buſtle; for I hate all ſtrife,
And love an eaſy, a contented life.
And yet 'tis ſtrange I oft' delight to vex
Deluded mortals and their minds perplex;
For I my ſhape can eaſily transform,
To do ſome good, to others nought but harm;
To the heart wounded I can be a friend,
And gladſome conſolation ſwiftly ſend.
And oft with liberal hand do I ſupply
Thoſe who are pinch'd with griping poverty.
To the alchymiſt is my bounty ſhown,
Through me he gains the philoſophic ſtone!
I feed the glutton with the choiceſt meats,
Before him place Epicurean ſweets.
The lover, who unpitied by the maid,
His heart delights on, ſeeks the ſorrowing ſhade
The livelong day; and with heart-burſting ſighs,
Wails his loſt hope as fruitleſs ſacrifice;
In me finds ſwift relief for all his pain,
His utmoſt wiſh I make him to attain.
When Eloiſa, penſive and alone,
For wounded Abelard pours forthher moan,
I give the eaſe that ſhe was wont to find;
Shew himthe ſame as when he firſt was kind.
Th' aſpiring ſoldier in his burniſh'd arms,
Panting for glory and for war's alarms,
Is lead by me to the embattled fields,
Where victory a noble harveſt yields.
'Tis thus at times unheedful of which ſtate
I pay my viſit to the poor and great,
But in me nothing's laſting, nothing's true
As quickly, gentry, will be found by you.

Anſwers to the MATHEMATICAL QUESTIONS propoſed in laſt Year's DIARY.

[52] I. Queſtion, anſwered by Mr. Barker.

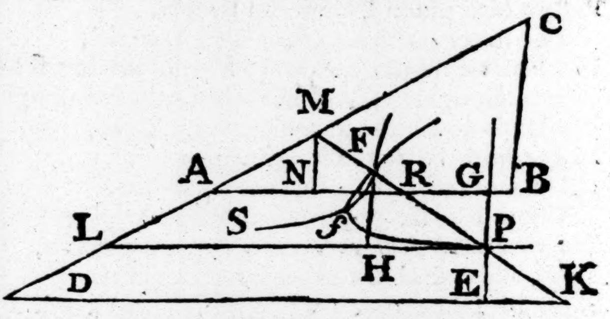
Make an angle equal to the given angle at the vertex, and let its containing ſides be each equal to half the given perimeter; and let the circle of equal perimeters be drawn as in the figure at page 25 of laſt Year's Diary, then (ſtill referring to the ſaid figure) draw parallels to the ſides A F and A B at the diſtances of two of the given perpendiculars; and from the point where they interſect each other, as a center, with the diſtance of the other perpendicular, deſcribe a circle; then a tangent to the circle thus deſcribed and the circle of equal perimeters will by its interſection with the lines containing the given angle, form the triangle required.

The demonſtration is evident from the theorem aforeſaid.

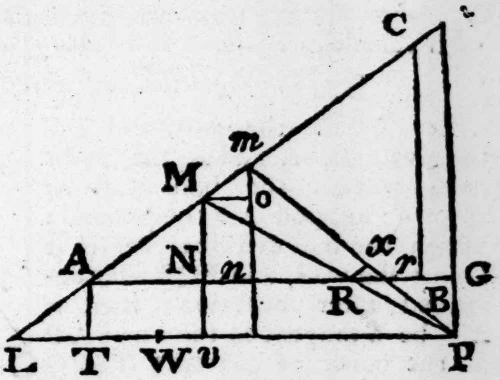
This queſtion was anſwered nearly in the ſame manner by Meſſrs. Pepys, Penſon, Barkwith, Quail, Hampſhire, Rogers and Clarke.

[53] II. Queſtion, anſwered by Mr. J. Ainſworth.

This queſtion does not ſeem capable of being *generally* conſtructed by the interſection of right lines and circles only; but may, by means of any of the conic ſections and a circle, or in a very ſimple manner by means of two hyperbolas; thus, draw P G $\perp$, and P L $\parallel$ to A R, meeting M A produced in L; alſo at the ſame diſtance from P L, that A R is, and $\parallel$ thereto draw D E. Then to the aſſymtotes D E, D M and through the point D draw an hyperbola P F; alſo to the aſſymtotes P L, P G and having a power equal to double the given triangle, deſcribe another hyperbola F S, interſecting the former in F. Then through F draw P R F M and the thing will be done; for let fall the $\perp$'s MN, FH; then, by the nature of the hyperbola P F, $FM = PK$ (by reaſon of the equidiſtance of the parallels A R, L P and D K) $= PR$, to each of theſe add F R and $MR = PF$ wherefore the $\triangle$'s R M N and P F H are equal and conſequently $MN \times NR = FH \times HP$ (by the nature of the hyperbola F S and conſtruction) $=$ double the given triangle. Q. E. D.



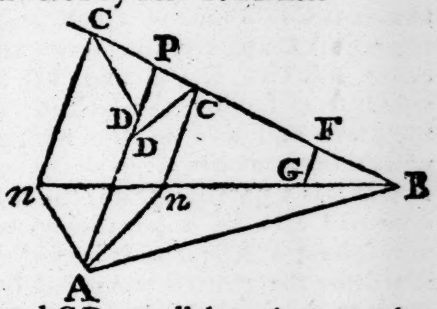
But



But the conſtruction of the caſe where RNM is a maximum, may (without a conic ſection) be thus inveſtigated, draw $PL \parallel$ to AR meeting MA in L, produce MN to v, biſect LP in W, and let Pm be ſuppoſed indefinitely near to PM, $Rx \parallel$ to Mm mn to MN and Mo to Nn; then will $RN \times NM = rn \times nm$ or $RN : rn :: nm : NM$ and by converſion $RN : RN - rn\ (Nn - Rr) :: nm : mo$, and alternately, $RN : nm :: Nn - Rr : mo$, that is, in its ultimate ſtate $RN : NM :: Nn - Rr : mo$. but $NM : AN :: mo : Mo\ (Nn)$ therefore ex-equali $RN : AN :: Nn - Rr : Nn$ and by diviſion, $AN - RN : AN :: Rr : Nn$, that is per ſimilar figures $Lv - vP\ (2Lv - LP) : Lv :: Rr : Nn$. Now $Rr : Rx :: LP : LM$ alſo $Rx : Mm :: PR : PM :: LT : Lv$ and $Mm : Mo\ (Nn) :: LM : Lv$; therefore, $Rr : Nn :: PL \times LT : Lv^2$; conſequently, from what was before ſhewn, $2Lv - LP : Lv$ or $\overline{2Lv - LP} \times Lv : Lv^2 :: PL \times LT : Lv^2$ wherefore $\overline{2Lv - LP} \times Lv = PL \times LT$ and taking the halves $Wv \times Lv = WL \times LT$. Hence this *conſtruction*, draw $PL \parallel$ to AN, let fall the $\perp$ AT, biſect PL in W and make $Wv \times Lv = WL \times LT$, raiſe $vM \perp$ to LP join PM and RNM will be the maximum triangle required.

This queſtion was alſo anſwered fluxionally by the Propoſer, and Meſſrs. Pepys, Rogers, Clark, Barker, Edwards, Hampſhire, &c.

[54] III. Queſtion, anſwered by Mr. T. Barker.



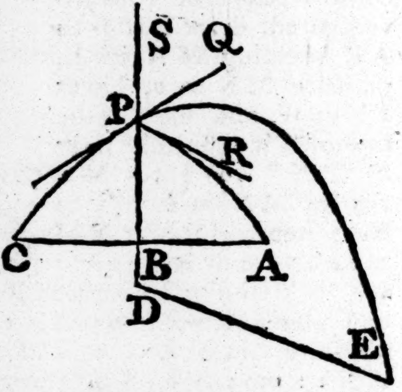
Let BAP, ABP and AB, be the two given angles and the included ſide of the trapezium; let BF be to FG in the given ratio of the ſides, and let FG be parallel to AD; join BG and from the center A with the diſtance An, equal to the other given ſide, interſect BG produced in n; draw nC parallel to AP meeting BP in C, and CD parallel to An, meeting AP in D; then ABCD is the trapezium required.

For $ADCn$ is a parallelogram by conſtruction, therefore, CD is equal to the given ſide An, and $AD = Cn$; but $AF : FG :: BC : Cn$; therefore, BC has to AD the given ratio; wherefore ADCB, &c.

N. B. This problem is uſeful in finding where two globes meet, &

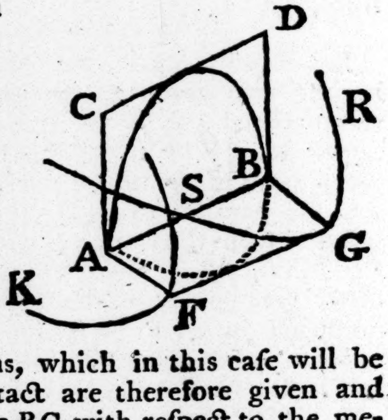
&c. when moving from two given places in given directions, and with velocities whoſe ratio is alſo given.

[55] IV. Queſtion, anſwered by Mr. G. Pepys.



Let DP be the wall, and DE the given plane, and A the point from whence the ball muſt be thrown: Suppoſe AP the parabola which the ball deſcribes before it ſtrikes the wall, and PQE that deſcribed after reflexion; then if RP be a tangent to the curve AP at the point of contact; if SPQ be made equal to BPR, becauſe the angles of incidence and reflexion are equal; PQ will be a tangent to the curve after reflexion; and as QP is a tangent if the curve AP be taken on the contrary ſide of BS, ſo that BC be equal to AB, the ball will move from C, if the wall was away, in the ſame manner as if it was firſt to deſcribe AP and then PQE; the queſtion is therefore reduced to finding in what direction the ball ſhall move from C to have the greateſt range poſſible on a plane DE given in poſition: Hence this conſtruction: Let ABC be perpendicular to BP, and take BC = AB, then find the direction at C ſo that the range on the plane DE may be the greateſt poſſible (which is done in the 11th problem of Mr. Burrow's Eſſay on Projectiles) and if an equal angle be taken at A in a contrary direction, the thing will be done.

[56] V. Queſtion, anſwered by Mr. Geo. Pepys.



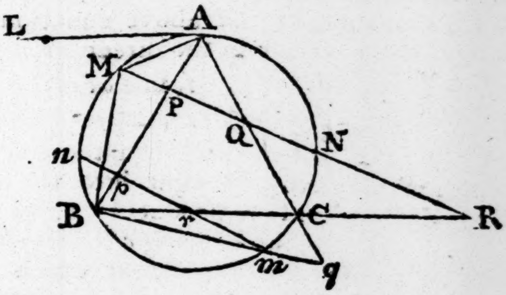
From what has been written on the paths of ſhadows, it is known that if ACDB be the given wall, the points C and D will deſcribe the conic ſections KFS and SGR, which from having the latitude of the place and day of the month, will therefore be given; and as ACDB is a parellelogram, the ſhadow will alſo be a parallelogram, whoſe baſe is AB; and it is evident it will be the greateſt when FG is a tangent to both the conic ſections, which in this caſe will be parallel to AB: the points of contact are therefore given and conſequently the poſition of the line BG with reſpect to the meridian, from whence the time of the day may be found: It is evident that the projected ſemi-ellipſe will have the ſame ratio to its circumſcribing parallelogram in the projection, as the original figures have to each other.

[57] VI. Queſtion, anſwered by Mr. George Pepys.

In this queſtion, in the ſame manner as the laſt, the vertex of the pole will evidently deſcribe a conic ſection, which may be eaſily determined from the *data* in the queſtion; wherefore the queſtion is reduced to drawing a perpendicular from a given point to the conic ſection; which is a queſtion that has already been reſolved by Meſſ. Coughron and Burrow in the Old Ladies Diary for 1772.

[58] VII. Queſtion, anſwered by Mr. C. H. Badger, the Propoſer.

C A S E 1ſt.



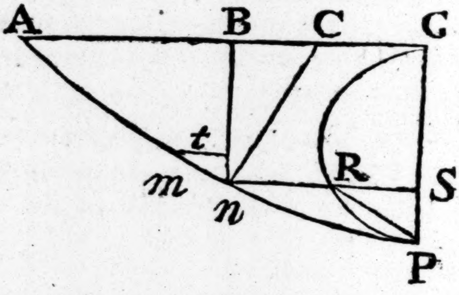
Put M A$=s$, M N$=c$, M P, M Q, or M R$=x$; then in the △ M A P, we have the ſine of A M P$=s\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}$, and drawing the tang. A L, the ſine of M A P (=L A P—L A M) $=\frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}-\frac{1}{4}s$; whence the ſine of A P M (= ſine of A M P + M A P) $=\frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}+\frac{1}{4}s$; ∴ by trig. as $\frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}+\frac{1}{4}s : s :: \frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}-\frac{1}{4}s : x$; which being equated and reduced gives, $3x^{2}-s^{2}x^{2}-6sx+s^{3}x+3s^{2}-s^{4}=0$. So in the △ M A Q, the ſine of A M Q$=s\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}$, and the ſine of M A Q (=MAP+PAQ)$=\frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}+\frac{1}{4}s$; whence the ſine of M Q A (= ſine of A M Q + M A Q) $=\frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}-\frac{1}{4}s$; ∴ as $\frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}-\frac{1}{4}s : s :: \frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}+\frac{1}{4}s : x$; which will produce the ſame equation as before found in the △ M A P whence it appears, that M P and M Q are denoted by the two roots of the above equation. Again, in the △ M B R, the chord of the are B M (=chord of the arc B A—M A) $=\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}-\frac{1}{2}$, ſine of M B R (=M B A + A B R) $=\frac{1}{2}\sqrt{3}\times 1-\frac{1}{4}s^{2}\,{}^{\frac{1}{2}}+\frac{1}{4}s$, ſine of B M R (=B M A—A M R) $\frac{1}{2}s\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}+\frac{1}{2}\sqrt{3}-\frac{1}{4}s^{2}\sqrt{3}$; whence the ſine of M R B (= ſine of M B R+B M R) $=\frac{1}{2}s$; ∴ as $\frac{1}{2}s : \sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}-\frac{1}{2}s :: \frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}\,{}^{\frac{1}{2}}+\frac{1}{4}s : x$; which being equated and reduced gives, $sx-3+s^{2}=0$, which brought into the equation ariſing from the △'s M A P and M A Q produces $3sx^{3}-s^{3}x^{3}-9x^{2}+18sx-6s^{3}x-9s^{2}+6s^{4}-s^{6}=0$, and ſubſtituting c for its equal $3s-s^{3}$ we have $cx^{3}-9x^{2}+6cx-c^{2}=0$; the roots of which will denote the values of M P, M Q, and M R. Q. E. I.

C A S E 2d.

Putting M A$=s$, $mn=c$, mp, mr, or—$mq=x$, then in the △ mBp, the chord of the arc mB (= arc Mm—B M) $=\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}+\frac{1}{2}s\sqrt{3}$, ſine of mBp= coſ. : M B P$=\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}$, ſine of $m p$B

(= ſine of M P A) $=\frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}+\frac{1}{4}s$; $\therefore\frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}+\frac{1}{4}s : \overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}+\frac{1}{2}s\sqrt{3} :: \overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}} : x$, which being equated and reduced gives, $3x^{2}-s^{2}x^{2}-4sx+s^{3}x-4+5s^{2}-s^{4}=0$. So in the $\triangle\ mCq$, the chord of the arc mC (= arc $BC-mB$) $=\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}-\frac{1}{2}s\sqrt{3}$, ſine of mCq = ſine of mCA = ſine of $mBp=\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}$, ſine of mqC (= M Q A) $\frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}-\frac{1}{4}s$; $\therefore\frac{1}{2}\sqrt{3}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}-\frac{1}{4}s : \overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}-\frac{1}{2}s\sqrt{3} :: \overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}} : -x$; which will produce the ſame equation as before found in $\triangle\ mBp$; whence it appears that *mp* and *mq* are denoted by the two roots of the above equation, *mq* being negative, as being taken contrary to the direction *mn*. Again, in the $\triangle\ mCr$, $mC=\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}-\frac{1}{2}s\sqrt{3}$, ſine of $mCr=\frac{1}{2}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}+\frac{1}{4}s\sqrt{3}$, ſine of $mrC=\frac{1}{2}s$: $\therefore\frac{1}{2}s : \overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}-\frac{1}{2}s\sqrt{3} :: \frac{1}{2}\times\overline{1-\frac{1}{4}s^{2}}|^{\frac{1}{2}}+\frac{1}{4}s\sqrt{3} : x$, which being equated and reduced, gives $sx-1+s^{2}=0$, which being brought into the equation ariſing from the $\triangle$s, mBP and mCq, produces $3sx^{3}-s^{3}x^{3}-3x^{2}+4-9s^{2}+6s^{4}-s^{6}=0$, and ſubſtituting c for its equal $3s-s^{3}$, we have $cx^{3}-3x^{2}+4-c^{2}=0$, the roots of which will denote the values of *mp*, *mq*, and *mr*. Q. E I.

[59] VIII. Queſtion, anſwered by Mr. T. Todd, the Propoſer.



If A n P be the curve of ſwifteſt deſcent; then (by p. 491, Simpſon's Fluxions) whatever be the nature of the force, the velocity will be $=\frac{b\dot{x}}{\dot{z}}$, ſuppoſing $AB=x$, $Bn=y$ and $AN=z$; and becauſe the velocities acquired in deſcending through An and Bn are equal, therefore $F\dot{y}=v\dot{v}$ and $F=\frac{v\dot{v}}{\dot{y}}=\frac{b\dot{x}}{\dot{y}\dot{z}}\times$ fluxion of $\frac{b\dot{x}}{\dot{z}}$.

1. Let A n P be a parabola, whoſe parameter is $2a$; then if n C be perpendicular to the curve, $BC=a$, and $Cn : nB :: \dot{z} : \dot{x}$, that is, $\sqrt{a^{2}+y^{2}} : y :: \dot{z} : \dot{x}$, therefore $v=\frac{b\dot{x}}{\dot{z}}=\frac{by}{\sqrt{a^{2}+y^{2}}}$, and $F=\frac{v\dot{v}}{\dot{y}}=\frac{b^{2}a^{2}y}{\sqrt{a^{2}+y^{2}}}$.

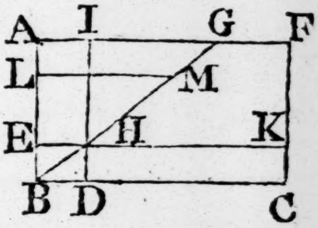
2. Let A n P be a circle; C its center; radius $Cn=a$; then $y :: \dot{z} : \dot{x}$, and thence $v=\frac{b\dot{x}}{\dot{z}}=\frac{by}{a}$; wherefore $F=\frac{b^{2}y}{a^{2}}$.

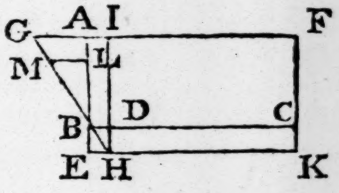
3. Let the curve A n P be a cycloid. $GP=a$; then becauſe triangles mtn and RSP are ſimilar, $RS : RP :: \dot{x} : \dot{z}$, but

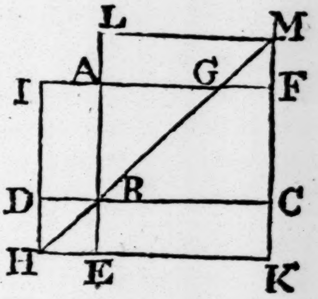
R S : R P : : $\sqrt{y}$: $\sqrt{a}$ therefore $v = \frac{b y^{\frac{1}{2}}}{a^{\frac{1}{2}}}$, and $F = \frac{v \dot{v}}{\dot{y}} = \frac{b^2}{2a}$.

4. Let A n P be the ellipſe : A G $= t$, G P $= c$; then $y^2 = \frac{c^2}{t^2} \times (2tx - x^2)$, and $v = \frac{b\dot{x}}{\dot{z}} = \frac{bt}{\sqrt{t^2 - c^2 + \frac{c^4}{y^2}}}$, conſequently the force of gravity F, or $\frac{v\dot{v}}{\dot{y}}$ becomes $\frac{b^2 c^4 t^2 y}{\overline{t^2 y^2 - c^2 y^2 + c^4}|^2}$; and by a ſimilar method, the force in the hyperbola is found $= \frac{b^2 t^2 c^4 y}{\overline{t^2 y^2 + c^2 y^2 + c^4}|^2}$.

[60] IX. Queſtion, anſwered by Mr. Ainſworth.







ANALYSIS. Imagine A B, B C (being two ſides of the rectangle A B C F) to be the two given lines ; E B, B D, alſo forming the rectangle B D H E, to be the other lines added to, or ſubtracted from the former, as the queſtion directs, and having a given ratio to each other; complete the rectangle I K, and let H B and A F meet in G; then ſince the ratio of D H to D B, that is (by ſimilar triangles) of A B to A G, is given, A G is given ; conſequently the ratio of H I to I G (equal that of A B to A G) is given, or the ratio of H I × I F to I G × I F; but H I × I F is given, therefore I G × I F is given, and conſequently the point I: hence this CONSTRUCTION.

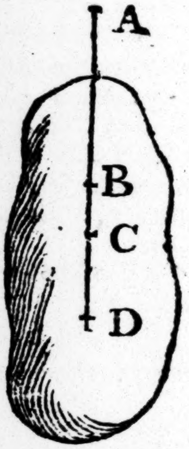
Let A G to B A be in the given ratio of E B to B D, and B A B L equal to the given ſquare; draw L M parallel to A F meeting B G in M; then make I G × I F = A B × L M, and the rectangle F I H K being compleated will give D B and E B the required lines.

DEMONSTRATION. For G I × I F : H I × I F : : G I : H I : : M L : B L : : A B × M L : A B × B L; but G I × I F = A B × M L, by conſtruction, therefore H I × F I = A B × B L; Alſo by ſimilar triangles E B : B D (E H) : : I G : I H. Q. E. D.

[61) X. Queſtion, anſwered by the Propoſer.

In printing this queſtion a ſmall preſs error was over looked, inſtead of $(3-2\sqrt{2})\times a=0$, it ſhould be $=a$: this premiſed, Let $a=r^2$ and $z=(\sqrt{2r^2-y^2}-\sqrt{r^2-y^2})^2$; then ſince $\frac{r^2}{\sqrt{z}}=\frac{r^2}{\sqrt{2r^2-y^2}-\sqrt{r-y^2}}=\sqrt{2r^2-y^2}+\sqrt{r^2-y^2}$, it is evident that $r^2-\frac{3}{4}\left(\frac{r^2}{\sqrt{z}}-\sqrt{z}\right)^2=y^2$, or rather $y^2=\frac{6r^2z-r^4-z^2}{4z}=\frac{6az-a^2-z^2}{4z}$; conſequently $6az-a^2-z^2=4zy^2$ therefore $2y\sqrt{z}=\sqrt{6az-a^2-z^2}$ and $2y=\frac{1}{\sqrt{z}}\sqrt{6az-a^2-z^2}$, and by taking the fluxion of the equation $\sqrt{z}=\sqrt{2r^2-y^2}-\sqrt{r^2-y^2}$ we have $\frac{\dot{z}}{\sqrt{z}}=2y\dot{y}\left(\frac{1}{\sqrt{r^2-y^2}}-\frac{1}{\sqrt{2r^2-y^2}}\right)$ and from multiplying theſe two equations, $\frac{\dot{z}}{z}\sqrt{6az-a^2-z^2}=\frac{4y^2\dot{y}}{\sqrt{r^2-y^2}}-\frac{4y^2\dot{y}}{\sqrt{2r^2-y^2}}$, the fluent of which is equal to twice the difference between the circular ſegments whoſe chords are each $2y$ to the radii r and $r\sqrt{2}$ reſpectively, that is, when $y=r$, or $z=r^2=a$, it will be twice the difference between a ſemicircle to radius r and the ſegment of a quadrant to radius $\sqrt{2}\times r$, which is well known to be equal to $2r^2$ or $2a$, the quantity ſought; for the fluent requires no correction ſeeing that it vaniſhes as it ſhould do when $y=0$, or which is the ſame thing, when $\dot{z}=(\sqrt{2}-1)^2\times r^2=(3-2\sqrt{2})\times a$.

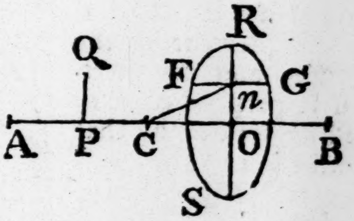
[62] XI. Queſtion, anſwered by Mr. Ainſworth.



Let B be the center of gravity of the body to be moved; C its center of gyration when ſuppoſed to revolve round B; D the point where the ſtroke is ſuppoſed to be made, and A a center of ſuſpenſion to the center of percuſſion D, Q equal to its quantity of matter, and B equal to the quantity of matter in the ſtriking body, having a velocity of b feet per ſecond.—Then will the motion of the body at its commencement, both angular and progreſſive, be the ſame as if it had been fixed at the point A; and therefore the velocity of the point D after the ſtroke will be $\frac{Bb}{\frac{AB}{AD}\times Q+B}=\frac{AD\times Bb}{AB\times Q+AD\times B}$; and conſequently its angular velocity $= \frac{Bb}{AB\times Q+AD\times B}$; which by the queſtion muſt be a *maximum*, wherefore $AB\times Q+AD\times B$ muſt be a *minimum*; which, ſince $AB\times BD=BC^2$ is conſtant, will happen when $B : Q+B :: AB : BD :: AB\times BD (=BC^2) : BD^2$, or $BD = \sqrt{\frac{Q+B}{B}}\times BC$; conſequently the velocity of the point D will be $\frac{Bb}{\frac{AB}{AD}\times Q+B} = \frac{Q+2B}{Q+B}\times\frac{1}{2}b$; and therefore the progreſſive motion of the center of gravity is $\frac{B}{Q+B}\times\frac{1}{2}b$; and if $c=3.1416$, the time of revolution round that center will be $\frac{2c\times(Q+B)\times AD}{(Q+2B)\times\frac{1}{2}b}$. In the preſent caſe $BC=\sqrt{13}$, $b=10$, $Q=1$, $B=1$, and $BD=5.099019$, $BA=2.54951$, $AD=7,64853$; and the progreſſive velocity of the center of gravity $=2\frac{1}{2}$ feet per ſecond, turning round that center at the ſame time once in 6,4076 ſeconds.

The ſame anſwered by Mr. J. Edwards.

Let RFSG repreſent a ſection of the cylinder $\perp$ to its axis AB; FG $\perp$ to RO; C the center of gravity, QP the direc. of the ſtroke from the ſurface. Put $AC=CB=l$, $RO=r$, $On=y$, $CP=z$, $v=$ circular vel. of the point P, $c=$ the vel. of the ſtriking body per ſecond, and $m=$its matter; ſince the cylin. after the ſtroke will revolve about an axis paſſing through C, and the force of any particle to reſiſt a momentum at P is as the ſquare of its diſtance from that axis, $4\dot{y}\times\overline{CO^2+y^2}\,\sqrt{r^2-y^2}$ will be the flux. of the force of the particles in the ſection; whoſe fluent is (when $y=r$) $\overline{CO^2+\frac{r^2}{4}}\times ar$: a being equal to the area of a cir. whoſe rad. is unity, put, now, $CO=x$. Then $2\dot{x}\times\overline{x^2+\frac{r^2}{4}}\times ar^2$ is the flux. of force of the whole cylinder, whoſe fluent $\left(\frac{l^3}{3}+\frac{r^2}{4}l\right)\times 2ar^2$ (when $x=l$) being $\div$ by z

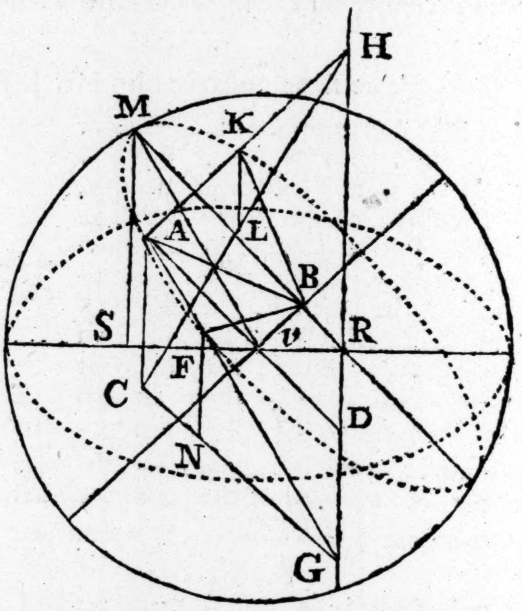


is the momen. at P whoſe vel. is C P: conſequently $\frac{bar^2 lv}{z^2}$ putting $b = \left(\frac{l^2}{3} + \frac{r^2}{4}\right) \times 2$ is the momen. when the vel. of P is $= v$. Then $bar^2 \frac{lv \times 2}{z^2} + mv = mc$ by a known Theorem; hence $v = \frac{cz^2}{b+z^2}$; and $\frac{v}{z} = \frac{cz^2}{bz+z^3}$ muſt be a max. per queſt. which being fluxed and reduced, gives $z = \sqrt{b} \left(\frac{l^2}{3} + \frac{r^2}{4} \times 2\right) = \sqrt{26} = 5.099$; and $v=5$ feet per 1 ſec. and time of revolution $= 6{,}4$ ſeconds.

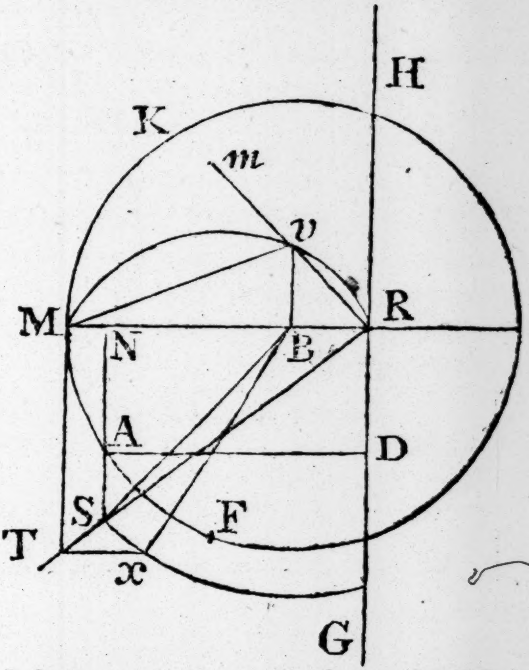
[63] XII. Queſtion, anſwered by Archimedes.

Analyſis.

Let F, A and K, be ſuppoſed the three places where the ſun was obſerved in its parallel of declination; F N, A C, K L being ſuppoſed the ſines of the altitudes, let fall perpendicular on the plane of the horizon meeting it in N, C and L; then becauſe the angle of interſection of the horizon and the ſun's parallel of declination, is the complement of the latitude, and the meridian is perpendicular to the line formed by that interſection; the problem is reduced to the determination of the angle M R S, made by a plane cutting the two former planes at right angles to their interſection G H: Now becauſe the line of interſection is in both planes, the lines A K and C L will meet in this line, and alſo A F and C N, and therefore H and G, the points where they meet will determine the line G H which is perpendicular to the meridian: but if A C and F N, or any two lines in the ſame proportion, be revolved about the line A F, ſo long as they remain parallel, the line C N joining their extreams will meet A F in the ſame point G, and the ſame reaſoning takes place, for AC and KL; and becauſe the angles FBA A B K,



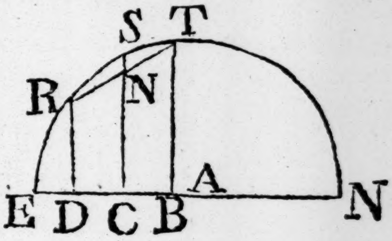
A B K, repreſenting the intervals of time, are given; if the radius of the parallel of latitude be aſſumed, the poſition of GH, and the lines MR, A D, will be given (A D being parallel to M R); and becauſe the triangles A D C and M R S are ſimilar, AD : MR : : AC : MS, therefore one angle and the ratio of the ſines being given, the meridian altitude MvS is given; conſequently the angle M v R is alſo given; and becauſe the point B is given, and B v perpendicular to B M, therefore v is alſo given and M v. Hence this CONSTRUCTION.

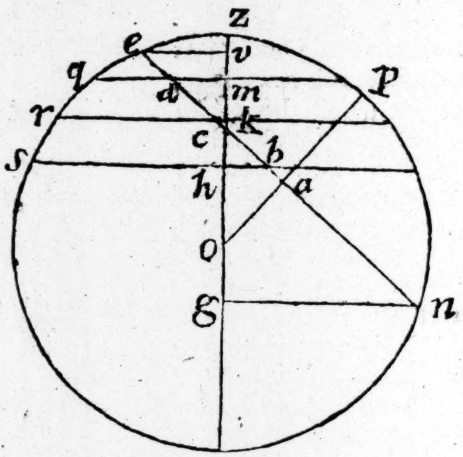


With any radius M B deſcribe a circle; make the angles F B A, A B K, equal to the intervals of time; let A K, A F be joined and produced, and let F N, A C, K L, be taken in proportion to the ſines of the altitudes, and parallel to each other, and C N C L being joined, will meet A F and A K in G and H; draw M B R through the center B perpendicular to G H, and make M B S equal to the altitude of A, and through A draw N A perpendicular to M R meeting B S in S; join R S and draw M T parallel to N S meeting R S in T; draw T x parallel to M R, meeting the arch deſcribed from the center B and diſtance B S in x; on M R deſcribe a ſegment of a circle containing an angle equal to the ſupplement of M B x, meeting B v perpendicular to B R in v: then B v R is the latitude of the place; B M v the ſun's declination; R v the ſine of the ſun's amplitude to the radius M v, and B R the ſine of the ſun's aſcenſional difference to the radius M B.

The ſame anſwered by Mr. Ainſworth.

In the orthographic projection of the ſphere on the plane of the meridian let o be the centre of the primitive circle z the zenith, $z\,q$, $z\,r$ and $z\,s$ the three given zenith diſtances; $q\,m$, $r\,k$ and $s\,h$ perpendicular to $o\,z$; alſo let the two intervals of time be the arcs R S,



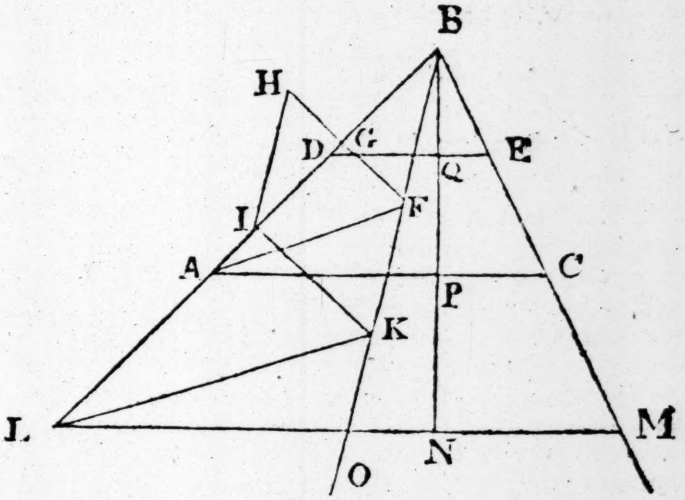


S T, join S T, and make R N to N I as *m k* to *k h*, then perpendicular to S N draw the diameter E C N, and let fall the perpendiculars R D, T B, and make *m v* and *h g* to *h m* as E D and B N to D B reſpectively; raiſe the perpendiculars *v c*, *g n*, and draw *e n* for the parallel of declination; perpendicular to which from the centre *o* draw P *o*, and P will be the pole, and P *z* the complement of the required latitude. For by reaſon of the parallels *e v*, *d m*, *c k*, *b h*, *g n* and conſtruction, *e d*, *d c*, *c b* and *b n* are to each other reſpectively as E D, D C, C B and B N, conſequently the two arcs *d c*, *c b* have the ſame meaſure as the arcs R S, S T the given intervals of time; whence the remainder of the conſtruction is manifeſt.

[64] XIII. Queſtion, anſwered by the Rev. Mr. Crakelt, the Propoſer.

Con. Conſtitute a triangle, A B C, which may have its vertical ∠, B, equal to that given, its perimeter, A B + B C + C A, equal to the given baſe and perpendicular or S, and the ſide of its inſcribed ſquare, D E, equal to the given radius or R; and having biſected the ∠s A and B with two indefinite lines A F and B O, from the point of their interſection F, let fall F G perpendicularly upon B A, and thereon produced take F H equal to D E: then through H draw H I parallel to B O to terminate in B A (produced if neceſſary), through I the line I K parallel to H F to terminate in B O; through K the line K L parallel to F A, and through L the line L M parallel to A C; and the triangle L B M will be that required.

Dem. Upon L M let fall the perpendicular B N, interſecting A C and D E in the points P and Q. Then the lines L K and L M being reſpectively parallel to A F and A C by *con.* the ∠ B L K will be = the ∠ B A F = F A C (by *con*,) = K L M, and conſequently K the centre of the circle that may be inſcribed in the triangle L B M, and its radius K I = F H (by the nature of parallels) = D E (by *con.*) = R. It remains then only to prove, that L M + B N is equal to S. Now by ſim. triangles B P : A C : : B Q = B P — Q P = B P — R : D E = R; or, by compoſition, B P + A C : A C : : B P : R. But, by a general property of triangles, A C : A B + B C + C A = S : : F G : B P; therefore *ex æqua peturbatè*, BP + AC : S :: FG : R; or, by permutation BP + AC : FG :: S : R. Moreover, by ſimilar triangles, BN : LM :: BP : AC; or, by compoſition, permutation, &c. BN + LM : BP + AC :: BN : BP :: BL : BA :: LK : AF :: KI : FG; or, by permutation again, &c. BN + LM : KI :: BP + AC :: FG :: S : R : but KI = R, and conſequently BN + LM = S.



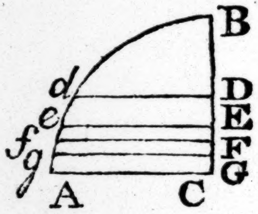
A different and very elegant ſolution was alſo given by Mr. Ainſworth, it was alſo very well ſolved by Mr. Pepys, Mr. Rogers, and Mr. James Wolfenden, of Hollingwood, near Mancheſter.

[65] XIV. Prize Queſtion, anſwered by Curioſus.

Inveſtigation. Here A. ſin. a, ſignifies the arc whoſe ſine is a, &c. $\left.\begin{array}{l}\text{A. ſin. } a + \text{A. ſin. } b + \text{A. ſin. } c\\ -\text{A. ſin. } b - \text{A. ſin. } c - \text{A. ſin. } d\end{array}\right\} = \text{A. ſin. } a - \text{A ſin. } d$, and ſo on, how far ſoever the ſeries may be carried : Now the ſine of A. ſin. a—A. ſin. $b = a\sqrt{1-b^2} - b\sqrt{1-a^2}$ and therefore A. ſin. a — A. ſin. b=A. ſin. $(a\sqrt{1-b^2} - b\sqrt{1-b})$; therefore A. ſin. a — A. ſin. d = A. ſin. $(a\sqrt{1-b^2} - b\sqrt{1-a^2}$ + A. ſin. $(b\sqrt{1-c^2} - c\sqrt{1-b^2})$ + A. ſin. $(c\sqrt{1-d^2} - d\sqrt{1-a^2})$, and if the ſeries be continued to an indefinite number of terms, ſo that the laſt may vaniſh, it is evident that the whole ſeries will be equal to A. ſin. a; wherefore if for a, b, c, d, &c. be ſubſtituted 1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c. the ſeries in queſtion will ariſe, and as $a = 1$ will conſequently be a quadrant. By ſubſtituting different values for a, b, c, &c. a numcer of other ſeries may be formed ; and by proceeding in a ſimilar manner for the coſines, tangents ; ſecants, &c. very many new ſeries may be diſcovered, and ſome that are exceedingly difficult to determine by the common methods.

The ſame anſwered by Mr. Ainſworth.

If $\frac{1}{n}$ and $\frac{1}{n+1}$ be the ſines of two arcs, $\frac{\sqrt{\overline{n+1}\,.\,\overline{n-1}}}{n}$ and $\frac{\sqrt{n\,.\,\overline{n+2}}}{n+1}$ will be their coſines, and conſequently, $\frac{\sqrt{n\,.\,\overline{n+2}}-\sqrt{\overline{n+1}\,.\,\overline{n-1}}}{n\,.\,\overline{n+1}}$ the ſine of the difference of thoſe arcs; if therefore in the quadrant A C B, radius C B $=1$, C D $=\frac{1}{2}$, C E $=\frac{1}{3}$ C F $=\frac{1}{4}$, C G $=\frac{1}{5}$, &c. and D *d*, E *e*, F *f*, &c. be drawn parallel to C A; the arcs B *d*, *d e*, *e f*, *f g*, &c. will be thoſe in queſtion, and conſequently the limit of their ſum will be the quadrantal arc B A.



In a manner nearly ſimilar it was anſwered by Mr. Quayle, Pepys, Edwards, Hampſhire, Wilſon, Dixon and lſenden, &c. But the Prize of Twelve Diaries fell to the lot of Mr. Ainſworth, and that of Eight, to Curioſus; alſo the Prize for the Solution of the Enigmas was the lot of Mr. J. Langdale; who are deſired to ſend to the Publiſher for them.

ARTICLE XXII.

A new method of determining the longitude of any place whoſe latitude is known, where the beginning, end, or any number of digits of a ſolar eclipſe; or the immerſion, emerſion or appulſe of a ſtar by the moon has been obſerved.

By J. KEECH.

LET the apparent time of the ecliptic conjunction of the ſun or moon, or moon and ſtar, be computed at ſome well known meridian, their longitudes, latitudes, parallaxes and diameters, their horary motions in longitude and latitude, right aſcenſion and declination, and the obliquity of the ecliptic *, find the angle of the earth, axis and moon's way, and the neareſt approach of the moon to the centre of the diſk, and the time thereof under the known meridian †, then by conſtruction or calculation, the longitude of the place of obſervation may eaſily be determined.

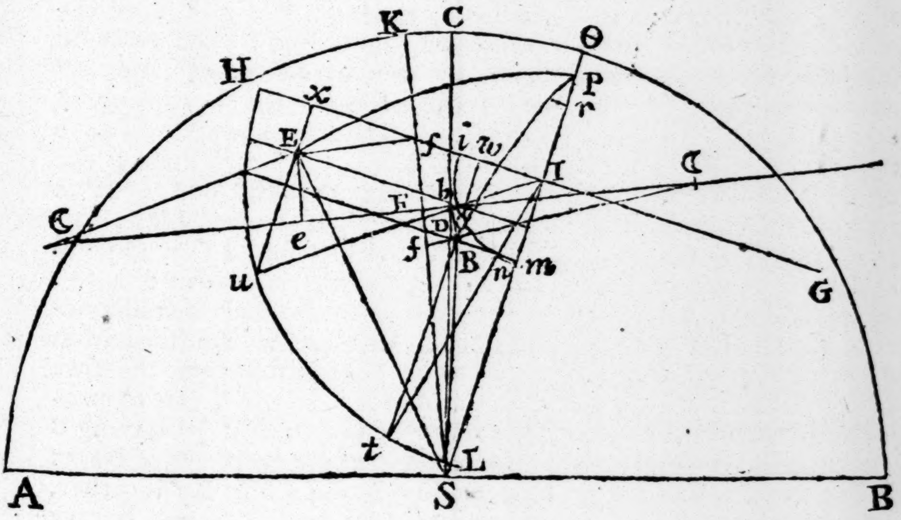
* All which may be had from the Nautical Almanack.

† Vide a method of computing ſolar eclipſes and occultations, in Mr. Hutton's Mathematical Miſcellany.

For Example. The beginning and end of a ſolar eclipſe was obſerved by Captain ——— Cooke, at one of the Burgeo Iſlands, near Cape Ray, the ſouth weſt extremity of Newfoundland, on the coaſt of America, in latitude 47°. 36′. 19″ north, on the 5th of Auguſt 1766: The beginning at 0 h. 46 . 48″ and end 3 h. 39′. 14″ apparent time in the afternoon, required the longitude of the place of obſervation.

By computation, I find the elements for Oxford, as follows, ecliptic conjunction of the ſun and moon, the 5th day of Auguſt, apparent time in the afternoon 5 h. 37′. 39″.

The longitude of the ſun and moon	4 ſ. 13°. 10′. 8″
Latitude of the moon, north deſc.	1959″,8
Horizontal parrallax of the moon ———	3243,0
Sun's horizontal parallax ———	8,5
Sun's ſemidiameter ——— ———	947,5
Moon's ſemidiameter ——— ———	884,5
Moon's horary motion in longitude ———	1769,5
Sun's ——— ——— ———	144,0
Horary motion of the moon from ſun ———	1625,5
Moon's horary motion in latitude ———	162,0
Sun's declination, north decreaſing	16°.53′.12″
Angle of the earth's axis to the *right* hand ——	16.32.42
Angle of the moon's way with the ecliptic to the *left* hand ———	5.41.29
The neareſt approach of the moon's centre, to the centre of the diſk ———	1949″,9
Apparent time thereof ———	5 h. 45′. 56″,4
Radius of the diſk ——— ———	3225″,4



Conſtruction. With the radius of the diſk taken from any ſcale of equal parts with the centre S, deſcribe the ſemicircle A C B, erect the perpendicular C S, make the angles C S ⊙ and C S K equal to the angles of the earth's axis and moon's way with the axis of the ecliptic, reſpectively make S F equal to the neareſt approach of the moon to the centre of the diſk S, and at right angles to K S draw ☽ F ☽ for the moon's path over the diſk, make the radius of the diſk, the radius of a line of ſines, from which, take *s m* and *s r* equal to the diſtance of the ſun from the vertex (or place of obſervation) at noon and midnight, biſect *m r* in I, and draw H I G through I at right angles to S ⊙, and make H I equal to I G equal to the ſine of the complement of the latitude from the ſame line of ſines, with I H and I *m* radiuſes deſcribe the quadrants I H L and I *m i*, take the arcs L *t* and L *u* equal to the time from noon, (in degrees) of the beginning and end of the eclipſe, draw *t* I and *u* I cutting I *m i* in *n* and *o* then parallel to I S, draw *t w* and *u x*, and parallel to I H, draw E *o* and B *n* interſecting each other in B and E, the place of the obſerver at the beginning and end, then with the ſum of the ſemidiameters of the ſun and moon, as radius and centers B and E croſs the moon's path in ☽ and ☽, the place of the moon at the beginning and end.

If now a ſcale of equal parts be made according to the moon's horary motion in her orbit, ☽ F ☽ taken from the firſt ſcale of equal parts, and divided into minutes, &c. then ☽ F and ☽ F being meaſured on the laſt ſcale, will give the time the moon is at F, or the neareſt approach under the unknown meridian, which compared with the known, will ſhew the difference of longitude ſought.

Calculation. Find the latitude in the ſpheroid = 47°. 20′. 30″, then in the ſpherical triangle P B S, having S P = 73°. 6. 0″ the complement of the ſun's declination (computed by the eſtimate longitude) P B the complement of the latitude = 42°. 39′. 30″ and the angle S P B, the time from noon of the beginning in degrees = 11°. 42′. 0″, find the ſide S B the ſun's zenith diſtance = 31°. 55′. 56″, and the angle P S B = 15°. 3′. 30″, hence the angle B S *f* is obtained = 7°. 10′. 41″. But as radius 90°. 3225″,4 : : 31°. 55′. 56″ : 1706″. 0, then in the right angled plane triangle B S *f*, having the angle B S *f*, and S B find S *f* = 1692″,6 and B *f* = 213″,2 : To the ſine of the the radius of the diſk 53′. 45″,4 add the Logarithm of the ſeconds in the ſun's ſemidiameter, and the ſine of the ſun's altitude, the ſum is the Logarithm of a number of ſeconds 12″,6 to be ſubtracted from the ſum of the ſemidiameters of the ſun and moon on the plane of projection, then in the plane right angled triangle D B ☽, having B ☽ = the corrected ſum of the ſemidiameters = 1819″,4, B *b* = F *f* = 257″, 3, find *b* ☽ = 1801,5 add *b* ☽ and F *b* = B *f* together, the ſum = 2014″,7 = F ☽ turned into time by the moon's horary motion in her orbit, gives 1 h. 14′. 0″ which added to 0 h. 46′ 48″ = 2h. 0′. 48″ the time the moon is at F, or time of the neareſt approach reckoned under the meridian, where the obſervation was made, but the moon is in the ſame point at Oxford at 5 h. 45′. 56″ the difference = 3 h. 45′. 8″ is = to the difference of longitude weſt.

By a ſimilar computation for the end, in the triangles P S E, S E *f*, and E *e* ☽, the difference of longitude will be found = 3 h. 45′. 16″, the mean is 3 h. 45′. 12″ the difference of longitude required.

When any number of digits is obſeived to be eclipſed, the method will be the ſame, only B ☽ will be equal to the correct ſum of the ſemidiameters, *minus* the part of the ſun eclipſed.

When an occultation, or emerſion of a ſtar, by or from the moon is obſerved, the computation will be the ſame, only inſtead of the moon's horary motion from the ſun, take her ſidereal horary motion in the ecliptic, (that is, her horary motion diminiſhed by a 365th. part of itſelf) for the latitude of the moon at conjunction, take the difference of the latitudes of the moon and ſtar, for the ſun's declination the ſtars; for noon, the ſtars tranſit over the meridian (which is the ſun's right aſcenſion in time ſubtracted from that of the ſtar) and for the ſum of the ſemidiameters corrected, the moon's ſemidiameter.

If an appulſe only of a ſtar be obſerved, B ☽ will be the diſtance of the moon's centre from the ſtar, and the reſt remain the ſame.

If a correſponding obſervation is made under the known meridian, the elements of the moon may be corrected, and made to agree with the obſervation, and then the longitude of the unknown place may be determined with the greateſt preciſion; but if not, the lunar Theory is now ſo well ſettled as to afford by this method (which very often occurs) a means of determining the longitude of places more correctly than they are at preſent.

Errata in laſt Year's Diary.

Page 27, in Mr. Ainſworth's ſolution, after $\frac{12.\ 11.\ 10.}{1.\ 2.\ 3.}$ read $(x-1.)$ In the tab. pag. 28, in the horizontal row in which is the letter D, the values of *r*, *s*, *t* ſhould be 3. 3. 4, in the next below 1. 4. 4, in the next 2. 3. 4, and the laſt 3. 3. 3. and in the ſame tab. for 77820241, read 77890241. In the 10th. Queſt. for "becomes = *o*," read becomes = *a*.

New

New Questions to be anſwered in next Year's Diary.

[66] I. Queſtion, by John the Farmer.

A Barters with B 40 pound of cloves, worth 6*s.* a pound, and 7*s.* and 6*d.* in barter, and would loſe 10 per cent to receive $\frac{1}{3}$ barter value in ready caſh: but B, as cunning as A, and likewiſe as honeſt, knows he will neither get nor loſe by putting his velvet in exchange at 21*s.* a yard. Required the real value of a yard of velvet, and the number of yards A muſt have of B.

[67] II. Queſtion, by Mr. Samuel Rogers, of London.

REQUIRED to draw tangents to curves repreſented by the the equations $a x^m \times b y^n = s$, $a x^m + \text{or} - b y^n = s$, where x and y ſignify lines drawn from the two foci, to any point in the curve.

[68] III. Queſtion, by Mr. Joſeph James, Stoke-Biſhop, near Briſtol.

A Heavy body will deſcend down the perpendicular height of a cone, in $2\frac{3}{4}$ ſeconds of time leſs than down the ſlant ſide; required the ſolidity of the ſaid cone when the ſame is a minimum?

[69] IV. Queſtion, by Mr. John Willes, of Marſk.

LET a given cylinder of copper be ſuſtained alternately in one point by two ſupports, one in a direction perpendicular to it, and the other in a direction perpendicular to the horizon, and at a given horizontal diſtance from its baſe or extremity: To find what degree of elevation the cylinder muſt have, ſo that the difference of preſſure upon the ſupports in each direction may be the greateſt poſſible.

[70] V. Queſtion, by Mr. John Hampſhire of London.

GIVEN the directrix of a conic ſection; its focus, and poſition of the tangent to determine the point of contact geometrically.

[71] VI. Queſtion, by Mr. James Wolfenden, of Hollingwood, near Mancheſter.

GIVEN the baſe and vertical angle of a plane triangle, to conſtruct it, when the rectangle under the line biſecting the vertical angle, and the difference of the ſides is the greateſt poſſible.

[72] VII. Queſtion, by Mr. Burrow.

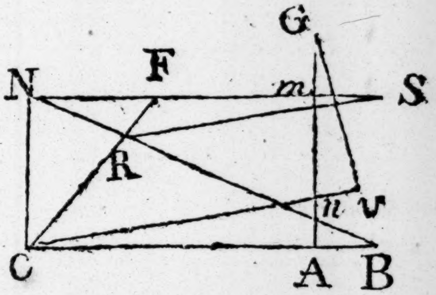
TO find the preſſure of the earth repreſented by the triangle C D T againſt the profile A B C D of a wall, in a direction perpendicular to the vertical line D C; and its momentum to overturn the wall about the point A; ſuppoſing the friction to be as the preſſure.

N. B. This problem is propoſed at p. 7, of Mr. *Muller's Practical Fortification*, and is made the foundation of his *theory of walls*; but as the principle of his ſolution is *not true*, and ſome material parts left unconſidered, it is here re-propoſed on account of its utility in building,

[73] VIII. Queſtion, by a Diſtiller of Oſweſtry.

A Publican ordered 36 gallons of rum, at eight ſhillings per gallon; I had rum worth twelve ſhillings per. gallon, 24 gallons of which I put in a veſſel, (whoſe content is juſt 36 gallons) and ordered my ſervant to fill it up with water; he placed the veſſel to receive the water from a pipe (that conveys water from an excellent ſpring) and obſerving that the veſſel fill'd ſlowly, went into the kitchen, where he was ſo agreeably entertained by the maid, that he forgot the veſſel. When I went to ſee if the veſſel was filled, I found the liquor running over the top, and the water running in, I ſtopped the water directly, and was told by the ſervant that it was ten minutes paſt four o'clock when he put the veſſel under, and I remember the clock ſtruck five juſt as I ſtopped the water. Now as I intend to make him pay the damage, Quere the value of the liquor in the veſſel, ſuppoſing the pipe diſcharges juſt 1 gallon in a minute.

[74] IX. Queſtion, by Mr. J. Merritt.



IF A C and C F be half the tranſverſe and conjugate diameters of an ellipſe, given in magnitude and poſition; then the magnitude and poſition of the axes of the ellipſe will be found as follows: Let N F S be parallel to C A; and C N and A G pependicular to it; let A G = C F, and take G*n* = C N, and let G *v* be perpendicular to C *n v*, then will C *v* and G *v* be equal to the ſemi-tranſverſe and ſemi-conjugate axes; and if C S be taken equal to C *v* and C B equal to N S, and N B be joined meeting C F in R, then R S will be parallel to the tranſverſe axis of the ellipſe. Required the demonſtration.

[75] X. Queſtion, by Mr. Iſaac Dalby.

TO conſtruct the trapezium, having given the angles, the [illegible] rimeter, and area.

This is Prob. 8. Cunn's edit. of Newton's Arithmetic.

[76] XI. Queſtion, by the Rev. Mr. Crakelt.

GIVEN the baſe of a plain triangle, one of the angles abo it, and the ſide oppoſite to the ſaid angle, a mean propo tional betwixt the other ſide and a given line; to determine t triangle.

[77] XII. Queſtion, by Mr. Moſs.

TO divide a right line into any aſſigned number of equal pa whatever, by only uſing *two extenſions* of the compaſſe more than the number of parts which the ſaid line is to be d vided into.

[78] XIII. Queſtion, by Dr. Wallis.

SIT Pyramidis vel Coni Fruſtum (parallelis planis abſciſſum Cujus Baſis major, æquetur quadrato rectæ A; minor, qua rato rectæ E; Altitudo F. Ducti ſi cruribus A, E, conſtituat angulus graduum 120, et compleatur triangulum, eique circu ſcribatur Circulus: Quadratum Radii circuli circumſcripti, Altitudinem Fruſti ductum, æquatur Fruſto.

Of this theorem (which was propoſed by the Dr. to *Monſ. F mat.*) a *Geometrical* Demonſtration is required.

[79] XIV. Prize Queſtion, by Mr. J. Ainſworth.

A Hollow ſphere, part filled with water, being made to revol uniformly round a diameter perpendicular to the horiz at the rate of three times in a ſecond; a ſegment was found be left dry at the bottom, and another at the top, the diamete of whoſe baſes were reſpectively eight and twelve inches: [illegible] required from thence to determine the quantity of water co tained in the ſphere?

Whoever anſwers the above Queſtion before the 1ſt of May, ha Chance, by Lot, to win Twelve Diaries, and another to win Ei Diaries.

⁂ The Editor having lately diſcovered that "*the lear and ingenious Profeſſor Hutton, Eſq;*" has contrived and found o ſome very unwarrantable means of getting and *keeping* Letters relative and ſpecified for the preſent Diary; *Mr. Barrow* therefo in order to prevent any *more* ſuch [illegible] behaviour; it [illegible] a neceſſity of deſiring his Correſpondents in future to favour with their Letters directed to him at No. [illegible] Fleet-Street.

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